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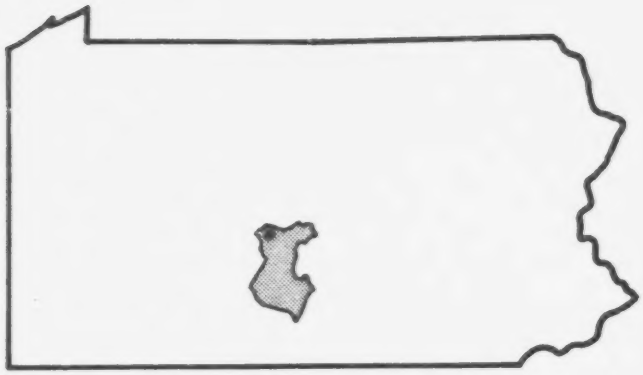
FLOOD INSURANCE STUDY

TOWNSHIP OF WARRIORS MARK, PENNSYLVANIA
HUNTINGDON COUNTY



MARCH 2, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER - **421705**

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWNSHIP OF WARRIORS MARK, HUNTINGDON COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Warriors Mark, Huntingdon County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the U. S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 8. This work was completed in March 1987.

1.3 Coordination

On December 13, 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, the township, and the USGS (the study contractor) to determine the streams to be studied by detailed methods.

On March 1, 1988, a final CCO meeting was held with representatives of FEMA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Warriors Mark, Huntingdon County, Pennsylvania. The

Borough of Birmingham is not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

Warriors Mark Run was studied by detailed methods from approximately 3,580 feet downstream of Burkett Road to approximately 270 feet upstream of State Route 550. Little Juniata River was studied by detailed methods from the lower corporate limits to Legislative Route 07030. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through March 1992.

The remaining portions of Warriors Mark Run and the Little Juniata River, and East Branch Warriors Mark Run were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Warriors Mark.

2.2 Community Description

The Township of Warriors Mark is located in the northwestern part of Huntingdon County in south-central Pennsylvania, approximately 14 miles northwest of Huntingdon. It is bordered by the Township of Snyder to the west, the Township of Taylor to the north, the Townships of Half Moon and Ferguson to the northeast, the Township of Franklin to the east, the Township of Spruce Creek to the southeast, the Township of Tyrone to the southwest, and the Borough of Birmingham to the southwest.

2.3 Principal Flood Problems

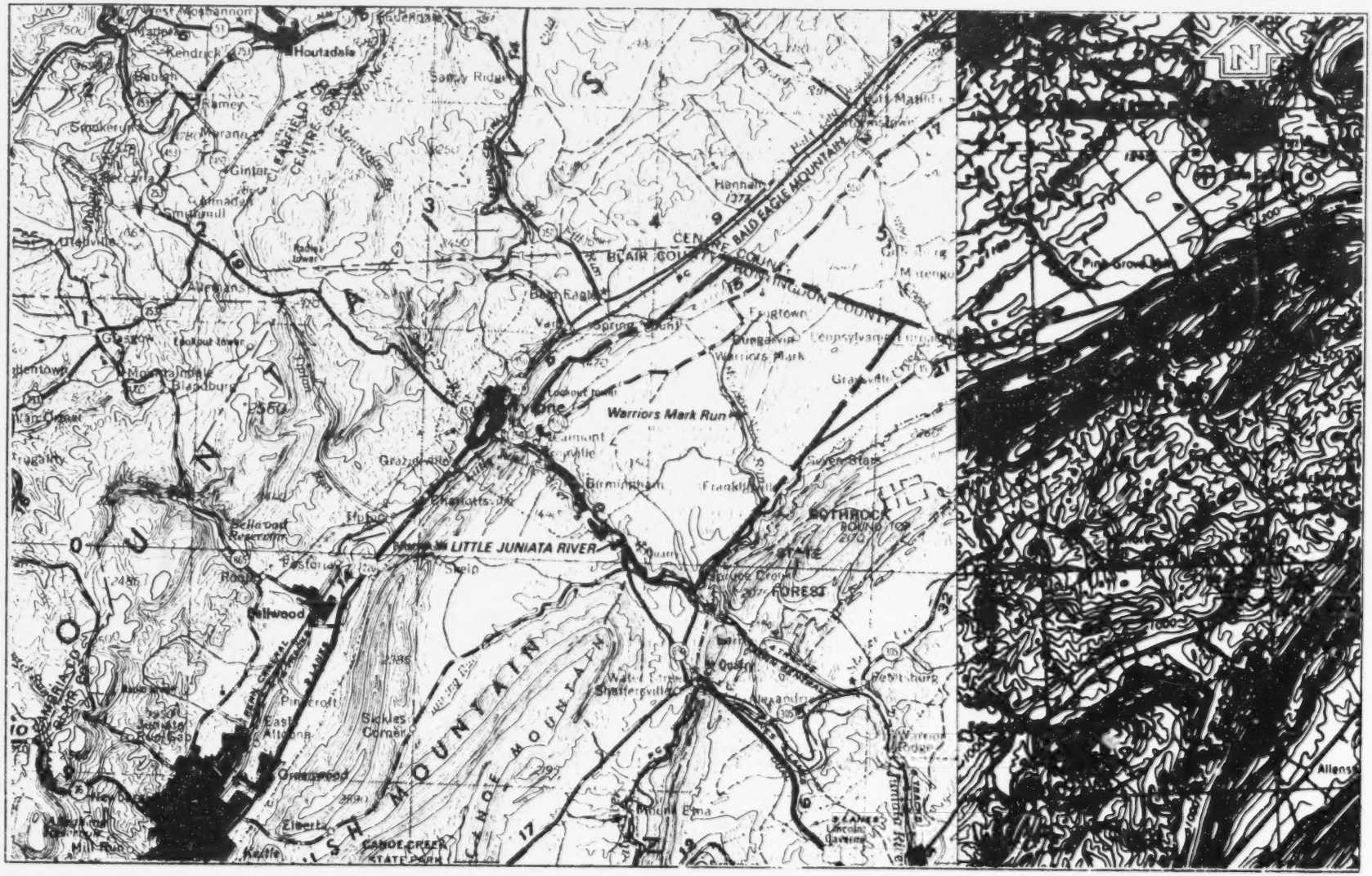
Major floods cause localized inundation of structures along Warriors Mark Run, East Branch Warriors Mark Run, and Little Juniata River.

2.4 Flood Protection Measures

No structures have been installed to alleviate flooding in the township.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases


Houtzdale
Ramey
Clearfield County
Centre County
Blair County
Huntingdon County
Bald Eagle Mountain
Warriors Mark Run
Bellwood
Bellwood Reservoir
LITTLE JUNIATA RIVER
Sinking Valley
Pinecroft
East Altoona
Sickles Corner
Ormsdale
Canoe Mountain
CANOE CREEK STATE PARK
Shaffers Gap
Mill Run
Allensville
Pine Grove Mills
Penn State Forest
Rothrock State Forest
Alexandria
Water Street
Shatterville
Birmingham
Franklinville
Graysville
Lemasters
Fairgrove
Dungarvin
Warriors Mark
Spring Creek
Bald Eagle
Lookout Tower
Logan Branch
Sandy Ridge
Hannah
Gaskill
Glasgow
Mountainside
Blandburg
Van Orsdel
Hublersburg
Fort Roberdeau
Tipton
Tyrone
Altoona
Juniata River
Canoe Creek
Penn Central
Conrail
Amtrak
Norfolk Southern
Penn Central
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when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The flood-frequency discharge values for Warriors Mark Run were determined utilizing regional regression equations developed in USGS Water Resources Investigations 82-21 (Reference 1).

The discharge value for the Little Juniata River was determined using the Bulletin 17B recommendations and data from the gages on the Juniata River at Huntingdon, and on the Little Juniata River at Spruce Creek and at Tipton (References 2, 3, and 4).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 100-YEAR
WARRIORS MARK RUN		
At downstream study limits	12.4	2,590
Below East Branch Warriors Mark Run	12.2	2,560
Above East Branch Warriors Mark Run	4.35	1,210
At State Route 550 in the Township of Warriors Mark	1.83	645
LITTLE JUNIATA RIVER		
At downstream corporate limits	184	25,100
At Legislative Route 07030	176	20,860

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections were field surveyed and located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. All bridges, dams, and culverts in the community were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2), where applicable.

Water-surface elevations of floods of the selected recurrence intervals for the Little Juniata River from the downstream corporate limits upstream to Legislative Route 07030, a distance of approximately 15,550 feet, were computed using the U. S. Army Corps of Engineers (COE) HEC-2 step-backwater computer program (Reference 5). The starting water-surface elevation was obtained from the Flood Insurance Study for the Township of Tyrone (Reference 3).

For Warriors Mark Run, from approximately 3,490 to 11,000 feet upstream of the lower corporate limits, normal depths of flooding for the 100-year recurrence interval were estimated from the regional relationship between drainage area and flood depth prepared by the USGS (Reference 6). This relationship was developed by means of regional regression analyses of basin areas and 100-year within-channel depths observed at stream gages. Depths were adjusted on the basis of hydraulic calculations to account for increased depth due to backwater from hydraulic structures, such as bridges and culverts (References 7 and 8). The starting water-surface elevation was obtained using the slope/area method.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of engineering judgment and field inspection of the floodplain areas. The roughness coefficients for the channel ranged from 0.030 to 0.038, and the overbank areas ranged from 0.043 to 0.100.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 9).

For the streams studied by approximate methods, the floodplain boundaries were delineated using the Flood Hazard Boundary Map for the Township of Warriors Mark (Reference 10).

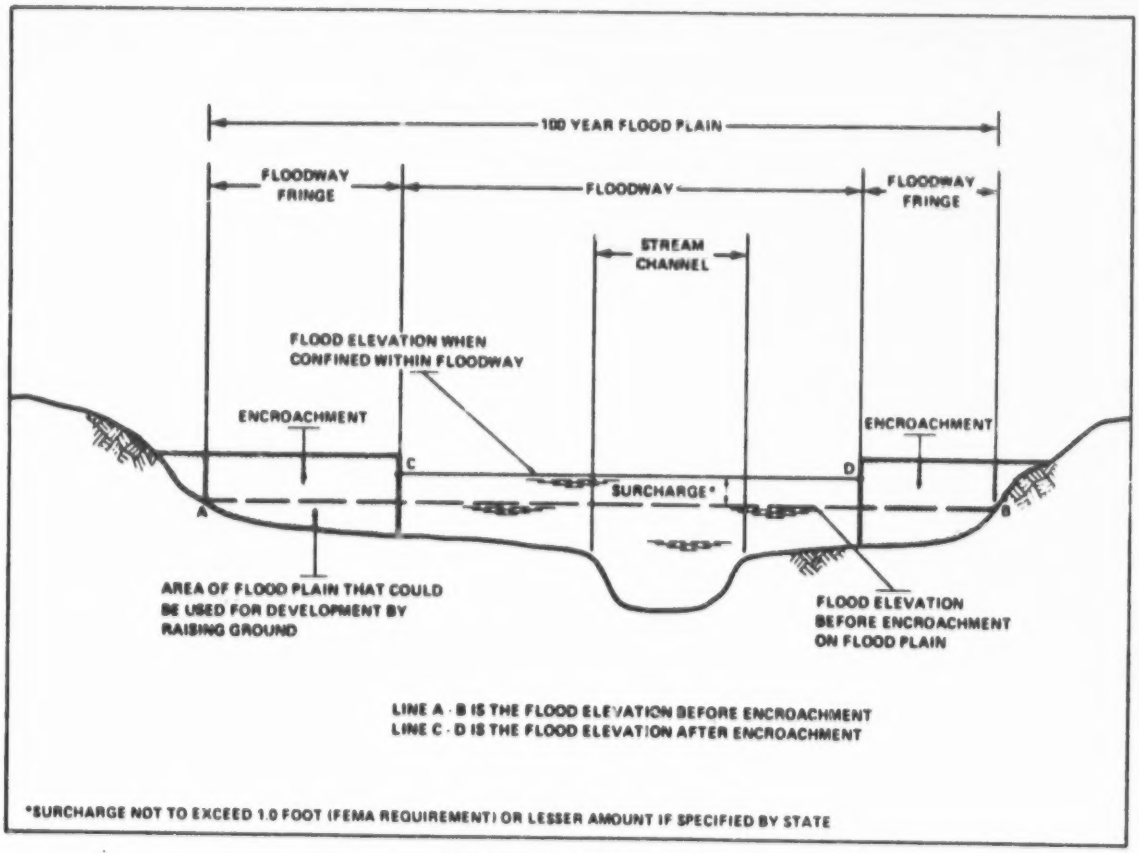
The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

No floodways were calculated as part of this study.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are

less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies for the Townships of Tyrone and Snyder have been prepared (References 3 and 4). The results of this study are in complete agreement with the results of those studies.

Flood Insurance Studies for the Townships of Spruce Creek, Franklin, and Ferguson are currently being prepared (References 11, 12, and 13). The results of those studies will be in complete agreement with the results of this study.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Warriors Mark (Reference 10).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 82-21, Evaluation of the Streamflow-Data Program in Pennsylvania by H. N. Flippo, Jr., Harrisburg, Pennsylvania, 1982.

2. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

3. Federal Emergency Management Agency, Flood Insurance Study, Township of Tyrone, Blair County, Pennsylvania, Washington, D. C., June 18, 1980.

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6. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 86-4195, Technique for Estimating Depths of 100-year Floods in Pennsylvania by H. N. Flippo, Jr., Harrisburg, Pennsylvania, 1986.

7. U. S. Federal Highway Administration, Report FHWA/RD-86/108, Bridge Waterways Analysis Model/Research Report by J. O. Shearman, W. H. Kirby, V. R. Schneider, and H. N. Flippo, Jr., Washington, D. C., 1986.

8. National Technical Information Service, Bridge Waterways Analysis Model/User's Instructions by J. O. Shearman, W. H. Kirby, and V. R. Schneider, Springfield, Virginia, 1985.

9. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Tyrone, Pennsylvania, 1963, Photorevised 1981; Franklinville, Pennsylvania, 1963, Photorevised 1972.

10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Warriors Mark, Huntingdon County, Pennsylvania, Washington, D. C., January 23, 1981.

11. Federal Emergency Management Agency, Flood Insurance Study, Township of Spruce Creek, Huntingdon County, Pennsylvania (Unpublished).

12. Federal Emergency Management Agency, Flood Insurance Study, Township of Franklin, Huntingdon County, Pennsylvania (Unpublished).

13. Federal Emergency Management Agency, Flood Insurance Study, Township of Ferguson, Centre County, Pennsylvania (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	10	1,055.61	PDH disk in northwest wing wall of State Route 45 TRK bridge over East Branch Warriors Mark Run, stamped 89 JWM 1961 USGS.
RM 2	10	1,029.89	PDH disk in west wing wall of State Route 45 TRK bridge over Warriors Mark Run, stamped 88 JWM 1961 USGS.
RM 3	15	881.96	USC&GS disk in southeast abutment of CONRAIL overpass of Legislative Route 07030, at southwest end of highway bridge over the Little Juniata River, stamped H 149 1941.
RM 4	15	857.53	USC&GS disk in northeast abutment of CONRAIL bridge 218/88 over the Little Juniata River, stamped G 149 1941.
RM 5	15	821.97	Chiseled square cut in southeast abutment of Tyrone Township Route T-506 bridge over the Little Juniata River.
RM 6	15	828.66	Chiseled square cut in northeast wing wall of CONRAIL bridge over the Little Juniata River, near State Route 453.

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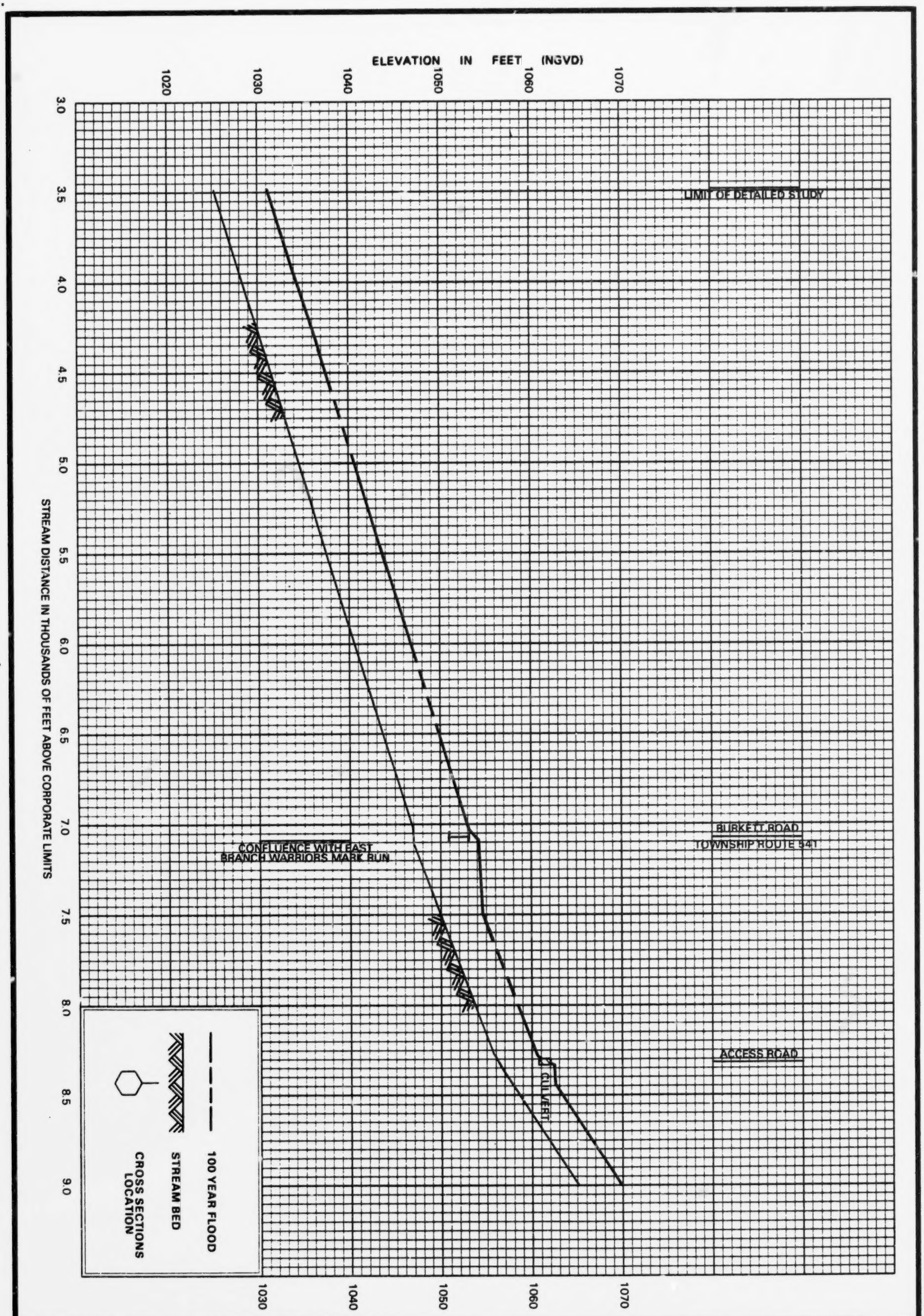

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WARRIORS MARK, PA

(HUNTINGDON CO.)

FLOOD PROFILES

WARRIORS MARK RUN

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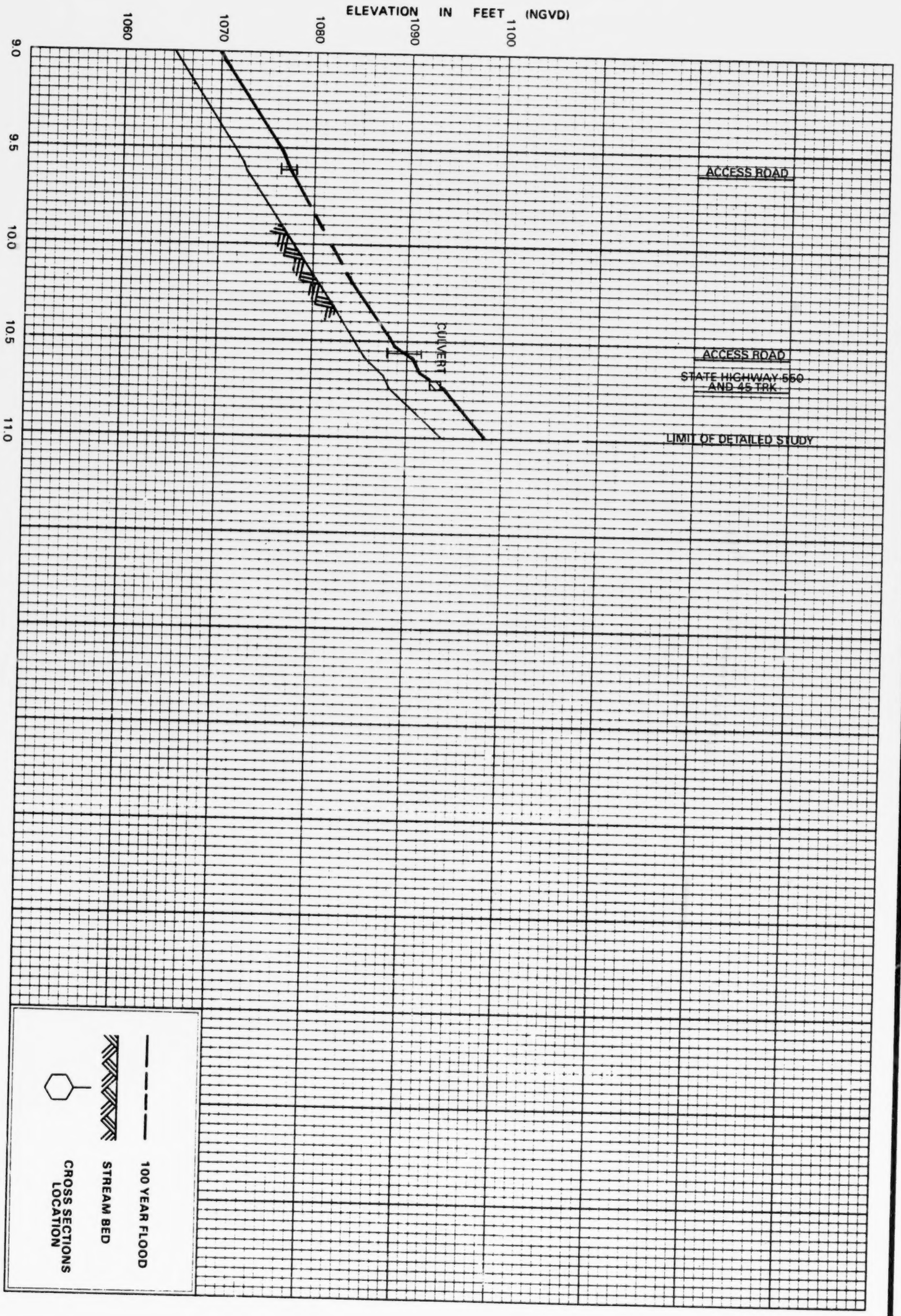

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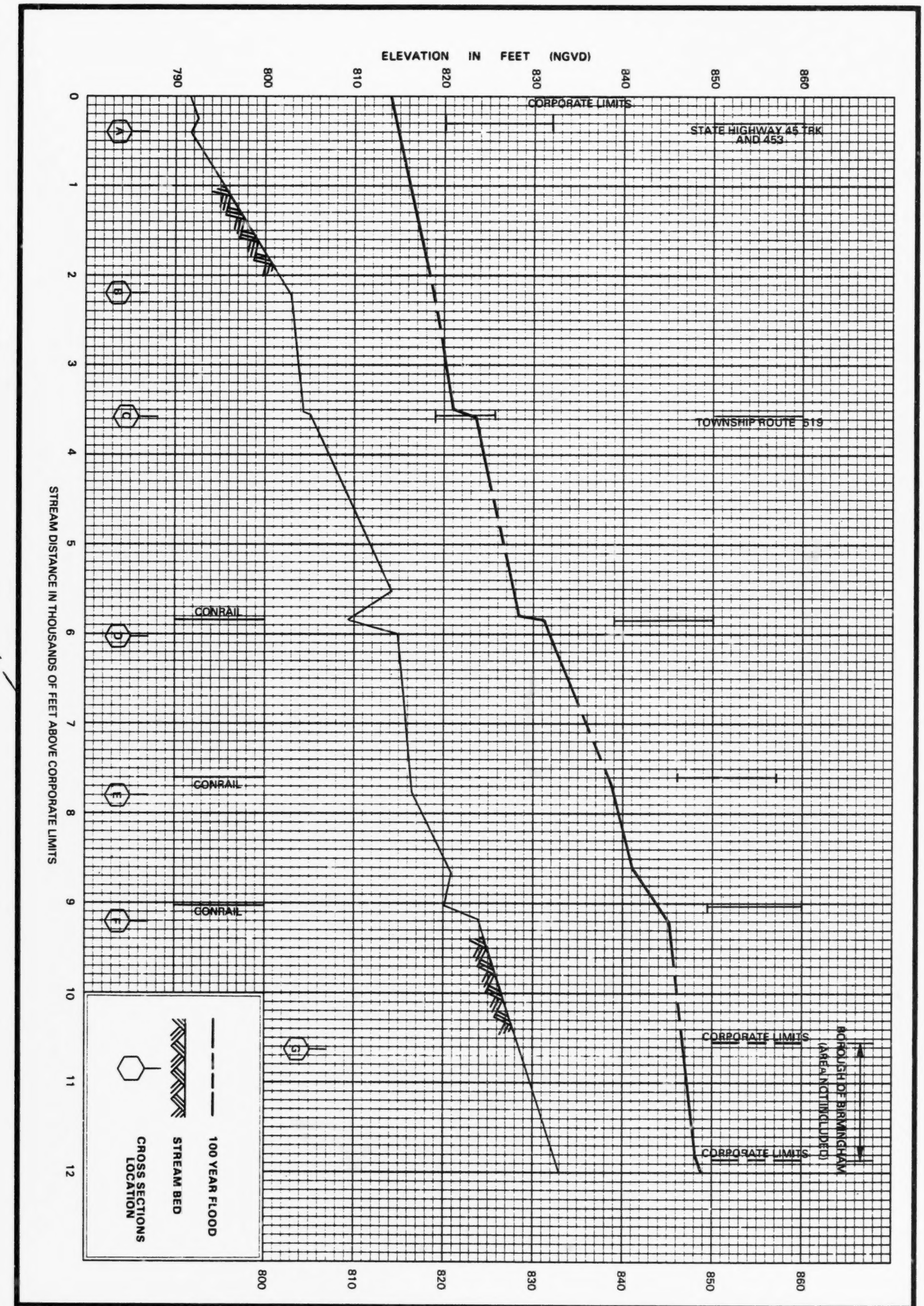
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WARRIORS MARK, PA
(HUNTINGDON CO.)

FLOOD PROFILES

WARRIORS MARK RUN



FEDERAL EMERGENCY MANAGEMENT AGENCY

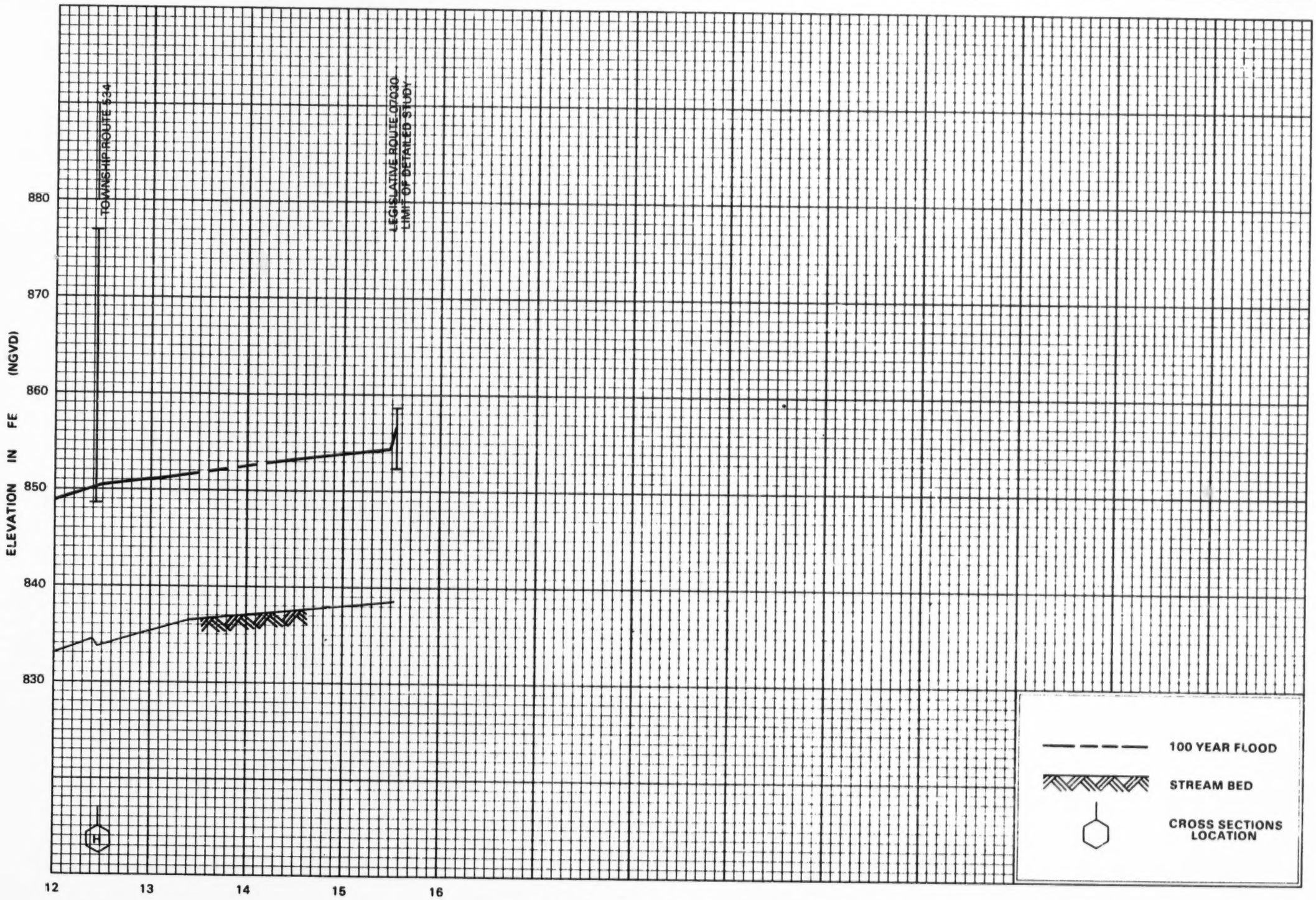
TOWNSHIP OF WARRIORS MARK, PA

(HUNTINGDON CO.)

03P

FLOOD PROFILES

LITTLE JUNIATA RIVER



FLOOD PROFILES

LITTLE JUNIATA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WARRIORS MARK, PA
(HUNTINGDON CO.)

04P